REMARKS

Applicant objects in most points to the Examiner's rejections in the January 17, 2003 Office Action with the following exception. Cited document JP 55-083,449 is about claim 85, which includes this invention. For this reason, the invention was excluded from the claims, so that four new generic claims result from that, which include the remaining inventions. Apart from that, the subordinate claims 90,95,99,107,108,109,111,112 are disclosed partly or for certain embodiments in the cited documents.

New claims 122-164 are submitted which will replace claims 85-121. These new claims are based on the claims submitted first in the United States, 43-84; the claims have been completed in some cases by changes in claims 85-121. Furthermore, the differentiation of two aspects of the edge in claims 43-84 were rescinded. The differentiation as such remains and is expressed in the claims.

No new matter is included in the new claims relative to the claims originally filed in this application.

However, there are some misunderstandings concerning some of the claims, which are cleared up in the following.

1. Comments on single points in the note:

Concerning points 2 and 6:

Obviously, there is a misunderstanding concerning the air gap 4.

The air gap is, with exception of the curved, continuous air gap, divided into air gap sections, through that every coil side runs.
See enclosure 1, picture 1 as section transverse to the moving direction.

The outer edges of the air gap in picture 1 are positioned where the winding head conductors or connecting conductors of two coil sides are. This is also the case if air gap 4 is arranged around the first body and includes a curved or folded coil.

In the case of a rotating machine, the outer edges of the air gap are positioned in the area near the axis, which is advantageous. This is shown in figure 5; the coil support 21 is led through the air gap area on one of the outer edges.

Other examples for a rotating form are shown in figures 14,18,22,24,31 and are described on page 11, lines 12-15, page 13, lines 26-34, page 16, lines 3-27 and the linear

realization on page 21, lines 7-14.

Concerning point 3:

The title "ELECTRICAL MACHINES" is the appropriate title for the invention, referring to a highly efficient electrical machine with its developments; the high efficiency is based on the technical realization of the direct and best possible conversion between conductor and magnetic field.

Concerning point 4:

In the Substitute Specification, page 2, line 15 it must be JP 0550083449 AA now instead of JP 55-083,449.

Concerning points 7 and 8:

The reference of the new claim 146 was changed to claim 145.

Concerning points 9 and 10:

The invention described in JP 55-083,449 is included in the inventions in claim 85,95,107,111. For this reason, the remaining inventions are described in the new claims 122-165 with the generic claims 122-125.

Claim 109 is partly disclosed in JP 55-083,449 .

Applicant traverses the rejections of claims 90,93-94,103,108,109 over the above-mentioned patent.

Objection to claim 90:

See page 6, lines 16-18 claim 90 is disclosed by other cited documents.

Objection to Claim 93:

This is a misunderstanding. If two neighbouring air gap sections blend into each other (enclosure 1, picture 2) this means that the boundary surface of both air gap sections border on each other, resulting in a closed air gap with a continuous field.

For this reason, claim 93 is rewritten more detail in new claim 134. (page 7, line 26 to page 8, line 13)

Objection to Claim 94:

In Patent JP 55-083,449 , in the figures 4,5,7 you can see two parallel air gaps, which are relatively wide apart. These air gap sections are, in the section across the moving direction, not connected to a third air gap, as described in claim 94 or in figures 24,4,36. (page 8, line 33 to page 9, line 5, page 8, lines 3-9).

Objection to Claim 103:

This is a misunderstanding.

In JP 55-083,449, figures 5,7 the second body follows the conductor with a uniform distance **up to** the folded region, but this is not the case **in** the folded region, where the conductor moves away from the outer pole with a beginning change of direction (curving or folding).

With the invention in claim 103 it is intended to use the folded region of the coil in the best possible way under the ideal conditions. This is not the case in JP 55-083,449, because the conductor follows the straight form of the second body (which is pointless) and goes off into the folded region in a right angle not until then. This results in high copper losses. An at least partly following of the conductor 20 in the folded region (as defined by claim 103) can be seen in figures 39,36,14,8,9. This provides an additional field for the conductor in the curved and/or folded region and it also shortens the air gap in this area. This also results in a consistent field distribution and straight lines of electronic flux. (page 15, lines 21-24)

Objection to Claim 108:

See Point 2. This claim is disclosed by other cited documents.

Objection to Claim 109:

From JP 55-083,449 , only parts of the claim's content are known.

Concerning points 11,12 and 13:

The objection to claim 100 is described first, it is then completed by the objection to claim 105:

US 4,763,053 describes a machine in which an air gap, in section transverse to the moving direction, is divided into three straight air gap sections, and in which two neighbouring air gap sections border on a canted edge with their boundary surface (belonging

to the inner return path body) at an angle of 90°. The flat wave winding which is used is thus folded around two canted edges. The folded region of the respective edge is permeated by a magnetic field of which the lines of electric flux generally run from one air gap boundary surface to another (claim 99).

This machine is an electronically commutated direct-current machine which uses a wave winding which has a one-sided contact with the return path material.

The machine was developed to result in an improved electronically commutated motor for storage media (column 4, line 55 to column 5, line 14, column 14, line 54 to column 15, line 26). For this application a coreless air gap was used (as it is standard in this area) because reluctance moments (caused by iron cores) are avoided and good synchronism characteristics will result from that. This development means an improvement of an existing motor principle which was developed for special applications.

The improved efficiency of the machine was reached by the improvement of the space factor (column 1, lines 38-45, column 3, lines 3-12). A better space factor was reached by doing without base material for the conductor (column 7, lines 45-49), by using a rectangular conductor cross section (column 7, lines 43-45) and increasing the number of coil sides (column 7, lines 5-8), especially in the area of the neutral zone by using two separate meandering, overlapping wave windings (column 4, lines 14-24, Fig. 10).

This invention from the US 4,763,053 was realized with a rather limited view and uses only a small part of Faraday's ideal conditions of direct energy conversion between conductor and magnetic field for the improvement of the machine's efficiency.
Increasing the use of copper in a coil is not seen as improvement here. This explains that the connecting conductor is positioned outside the air gap as winding heads, and in some types is even 90° offset, which increases the copper losses (Figs. 9,10,11).

Coreless air coils are used out of necessity to avoid reluctance moments. Being forced to enlarge the air gap is even seen as a disadvantage (column 3, lines 48-52). A further enlargement of the air gap to realize the ideal conditions is not seen as a solution principle for highly efficient machines. Would this be the case, the windings would not have been backed with return path material on one side, but freely movable conductors would have been used opposite the magnetic field. This means that only a part of the ideal conditions are realized and used for a solution of the problem.

Despite the existing folding of the coil it is not realized that the big benefit results from increasing the active conductor part in a bipolar coil (page 1, first paragraph), with the

same or less non-effective conductor length. It is only seen that a big part of the conductor can be put into a small space which is associated, in the best case, with a high performance (column 13, lines 16-21). It is ignored how important the use of copper in every bipolar coil is for the increase of the efficiency. The invention of the coil's folding is irrelevant. No one sees the big potential for improvement here, which is, compared to the other implemented inventory steps, remarkable.

Even in JP 55-083,449 not all aspects of the ideal conditions for direct energy conversion, discovered by Faraday, are grasped and considered.

Thus big parts of the conductor are in the girth area, but also in the area near the axis outside of the air gap. The meaning of copper use is largely underestimated here.

Apart from that it is ignored that the conductor parts in the girth area are, due to the high rate of speed, the most efficient conductor parts. Based on the construction shown here they have the same performance as both conductor parts together. These of all parts were not used in this construction.

The meaning of the use of free air coils was not realized, as in figure 1 a solution is shown which has coils with one-sided contact to the return path material.

In JP 55-083,449 the use of the magnetic material plays an important role as it was standard in the Nineties. This also explains the folding of the coil around the magnet, which results in the best possible use of the fields by an inner magnet arrangement. This means that also stray fields, which emerge from the front side of the girth area of the magnets, are partly used, as shown in figure 5. It has to be mentioned, however, that the stray field lines represent a minimal, neglectable part of the pole's magnetic induction and that the lines of magnetic flux often run slantwise so that they often do not reach the opposite return path at all and thus are not connected to the conductor effectively. This qualifies the statement in the abstract, construction, lines 23-25, that a big part of the coil contributes to the formation of the torque, as only single stray lines permeate the coil at the edge of the air gap sections. Furthermore, the statement is qualified considering that 42-46% of the conductor is, as seen in figures 3,4,7, positioned outside the air gap.

Resulting from Applicant's research work, connected with the ideal conditions of the direct energy conversion, it is most important for the improvement of efficiency (concerning the magnetic field) that the complete conductor is permeated by a strong field in the best possible way, as it is the case in an even air gap. This is not about a better use of the field, respectively the stray field by folding the conductor around the magnet. For this, the

conductor has to be prolongated and a best possible use of the conductor could never be reached.

Apart from that it has to be mentioned that the company Masushita Electric IND Co LTD manufactures only electronically commutated small-sized motors which are used for the actuation of storage media in the company's own devices (of daughter company Pioneer).

This means that here, to avoid reluctance moments, coreless air gap windings are used. A good argument for the use of air coil motors can be their weight which is only up to 50% of that of motors with iron-filled coils; apart from that a smaller diameter of the motors results from the folded coils, which is important for mobile devices.

This means that the ideas of ideal conditions for direct energy conversion were not used here for the development of the machine and the machines are not based on these principles. It is the same in JP 55-083,449 , where circumstances determine the use of air coils and folded air coils, which are not used according to the ideal conditions.

This means that not only the inventions in claim 100 and 105 are new and based on inventive acts as defined by American Patent Laws, but also the inventions in the new generic claims 122-125 and subordinated claims.

It would not have been obvious for a person of ordinary skill in the art, who has to design a highly efficient machine, to infer the pancake machine with utilization of the folded region from both cited documents or from the other cited documents.

Even if he considers the further development of the cited documents, more than one step in the development would be necessary. It is not possible, however, to simply provide the girth area of the motor according to JP 55-083,449 with magnets, as recommended under point 13, as there is no opposite return path on the first body. This means that the first step in development is to give up the arrangements of the inner poles and position them at the outside, which causes resistance as he wants to use the stray filed lines. He can also perform the step in development described in claim 101 (fig.4), where an air gap section is implemented in the girth area and the poles belong to different boundary surfaces in the neighbouring air gap sections. He can also perform the step in development described in claim 100 (fig. 8,14) and additionally attach magnetic poles to both sides of the conductor.

In addition to that Applicant submits that a person of ordinary skills in the art, who has to design a highly efficient machine, would not take the development of the machine into the same direction; and that he would base his work on these patents, as he would have a completely different view of the matter, because he does not know the advantages of

Faraday's view and would not implement them for practical use.

A person of ordinary skill in the art would, on the contrary, not see the reduction of copper as the solution of the problem. Thus he would not consider a folding of the coil in section transverse to the moving direction, because he would not see the advantages of that for the efficiency of the machine. He does see an increase of efficiency for the machines for special purposes with special demands, but he would not consider this approach for the development of a highly efficient motor or generator, as in his opinion the disadvantages of these concepts would predominate. For a person of ordinary skill in the art it is not obvious to divide the air gap into air gap sections and to combine that with the curving and folding of the air coil in section transverse the moving direction and to see advantages in that, or, to put it differently, it is not obvious for him to see these advantages and to realize them, as a basis for the division into air gap sections, by curving and folding the air coil.

It is not obvious for him because he does not develop the machine with the intention to put the ideal condition for direct energy conversion into action, because he does not consider the necessary principles of Faraday.

Today's person of ordinary skill in the art, a qualified engineer of electrical technology, special field electrical machines, would not be interested in these machines as the whole engineering profession concentrates its education content and its esteem on grooved machines. Faraday's fundamental studies and the ideal conditions (see page 9, last paragraph) derived from these studies are not seen in their entirety today and are not considered in their entirety as a solution, partly because the highly efficient use of employed means did not have priority up to now, so that the applied sciences and the whole engineering profession has concentrated on iron filled spools for more than a century now, losing Faraday's extensive knowledge, which was only obvious to a few interested in his theory, in the case they understood them, as Faraday was far ahead of his time. The loss in operating performance accompanying this technical development did not play an important role as the manufacturing price determined the machine's construction and still determines it.

In none of the cited documents are the ideal conditions of direct energy conversion, discovered by Faraday, seen and considered in their entirety. Only a few developers see small parts of this entirety and realize them for special purposes. But the whole potential of the entirety, which leads to a completly new machine philosophy and a modern, highly efficient branch of machines, is not grasped.

A person of ordinary skill in the art sees in JP 55-083,449 a motor for which the

developer tried to enclose the inner pole completely with a conductor and thus use the magnetic material in the best possible way. For this, conductors are used which come near to the axis in segments in an air gap, which is not new to this person of ordinary skill in the art, as he knows this from the usual pancake machines, but he thinks it to be disadvantageous, as the relative speed of the conductor opposite to the field in this front conductor decreases rapidly and the girth area of the conductors is not used. The fact that there are two parallel air gaps is not new to him, as he knows this from all known rotating machines. Apart from that he will find the machine rather bulky and sees that the surface of the coil is only partly permeated by a magnetic flux of the magnets, which he thinks is disadvantageous, as the magnetic flux of the poles is used but a big part of the coil surface stays unused and is not or only partially permeated by flux Φ. Apart from that, he would prefer the rather slim machine build of the usual pancake machines to a gain (which he thinks is negligible) by using the magnetic material, as magnetic material is much less expensive nowadays than when the here described machine development took place. The prices for high energy magnets will plummet in 2004, as the patents for the manufacturing process will run out.

In addition, a person with ordinary skill in the art will see the big air gap as particularly disadvantageous, as to him, the magnetic induction B in such an air gap is much smaller than in the small air gap of a groove machine. To him, the magnetic material in a groove machine is used in the best possible way, as the magnetic flux Φ is led through the coil in a concentrated way, without having to make the coil surface bigger or even misshapen.

If he had the job to improve the machine in JP 55-083,449 , he would not have the idea to optimise the machine according to Faraday's ideas, but he would ask himself how he could make the air gap in the machine smaller (in his opinion, the invention in US 4,763,053 would be a step in the right direction) and how to turn this into a machine with iron-filled coils. This would seem very hard to do from his view for a pancake coil, and even impossible, as the grooves in the area near the axis would not have enough space next to each other and because with overlapping windings (as in DC-machines, with that he wants to use the machine surface in a better way) large areas of overlapping conductors would have to be positioned outside of the groove area, which would lead to a smaller surface to use from his view. (This argumentation is described repeatedly in these about highly efficient machines). For this reasons the winding in US 4,763,053 is, in all probability, a barrel winding.

Nowadays, a person with ordinary skill in the art thinks, corresponding to his university education, in terms of calculation methods and does not orientate himself by the

conductors in the magnetic field like Faraday did, but concentrates on calculation methods which are based on the terms and equations defined by James Clerk Maxwell, 1855 in his publication "About Faraday's force lines", which is the mathematical description of Faraday's theory (described in Faraday's "Experimental studies about electricity", Series I to XXIX, 1831-1852), which include basically abstract calculations like the magnetic flux Φ, coercive field strength H, magnetic induction B and the magnetic permeability μ and in which the main emphasis is on the change in flux per time units $d\Phi/dt$ through a surface A and not like Faraday on the cutting of the conductor through field lines.

A person with ordinary skill in the art would try to find the calculation method which is usually known for the machines, and to look for the value within the formula to be changed for optimising, and only then he would try to find out what this means for the machine in reality. With this approach the surface A of the coil is (together with the length of the air gap) important as the only real value which is to be optimised in connection with the magnetic flux Φ. This model literally forces the developer to use iron in the coil, respectively the air gap, because the formula shows how big the influence of the material's permeability μ is and lets the air coil machines (with some exceptions, where not using iron is absolutely necessary due to the application, resp. the machine's construction) appear as hopelessly old-fashioned. With this background, a person with ordinary skill in the art would not see the machine with Faraday's eyes and he would not try to optimise the single components of Faraday's view in their entirety; and he would not see the air gap being positioned transverse to the moving direction, as the (for him) important surface A in the coil cannot be seen, so he would not get the idea to divide the air gap into sections which he positions in different ways. Nothing would be further from his mind.

Even the expert for small-sized motors, Helmut Moczala, expresses astonishment in his book "Electrical small-sized motors" (2nd edition 1993, page 166, lines 16-17) about the fact that ironless air coil motors have such a high efficiency. Here it becomes obvious that most of the knowledge, which has been gathered by Faraday from 1831 until 1852, has been lost or is obscured by an abstract mathematical machine philosophy.

Only if you know the result (in retrospect) and also the ideas on which it is based this all seems obvious, which is not the case. For all these reasons the use of the folded region in the invented machine and the invented machine in claims 100, 105 and the new claims 122-165 is, for person with ordinary skill in the art, not obvious. Even for the developer of JP 55-083,449 , who did not use iron in contact with and within the coil and wanted a better

use of the coil, these inventions were not obvious.

The invented machines of the claims 100, 105, 122-165 are not obvious to a person with ordinary skill in the art, because his views do not allow this and he does not base his developments on the realization of the above mentioned ideal conditions, which means he would not consider the construction necessary for this realization.

Further explanations can be found in the text on the pages 14-15, concluding remarks, which is valid for all these claims.

Concerning point 15:

Claim 86 is put into effect as generic claim 123 and is referred to in subordinated claims.

2. Further changes in the new claims 122-165

Claim 122

In claim 122 the claim 43 was supplemented by changes of claim 85. In addition "each two of which abut one another with" was replaced by "that with one of" for a better comprehensibility. The claim was restricted by "are straight and lie at angle to one another" from claim 91.

A person with ordinary skill in the art would not consider a machine like this, as explained above. In addition, he would see, with the at least one-sided axis approximation, an elongation of the winding head, which would mean that the use of it would lead, in a rotating machine, in an area of lower speed which cannot be seen as advantage, especially because poles would have to be attached. Apart from that, the manufacturing of the coils would be more complicated. For these reason, such a solution for making a highly efficient electrical machine would be far from obvious. A person with ordinary skill in the art would not consider a machine by combining all cited documents, either.

Claim 123

See Concerning point 15.

Claim 124

The use of the folded region of the coil is claimed by this generic claim.

Further developments of this inventions are in the claims 126,127,141,144,145,146, 147,149,150,154.

At the end of the claim, the use of the folded region was changed according to the subordinate claims 62, 65,66,67.

As folded region 18 of the coil conductors are visible which are positioned outside of the even air gap in the area of an edge of the first body of the field device.

A person with ordinary skill in the art would not have had the idea here to drive developments further in the direction of the use of the folded region, as he does not have Faraday's view. He would not take these little changes into account, which, in his eyes, also mean a high effort. He would miss the fact that the use of the folded region means huge gains, especially in the high speed area.

Claim 125

Claim 46 was supplemented by "parallel to one other" from claim 95. Further developments are included in the content of claims 139,140,151,160,162 and are shown in figures 27,28,29,30,31,32,33,34,35,36,37,38.

A person with ordinary skills in the art would not have the idea to drive development in this direction here, as he does not consider Faraday's view and because of this he would shorten the air gap and implement iron cores.

The one-sided contact of the winding with return path material shown in US 4,763,053, especially the increase of the space factor and the necessary shortening of the air gap connected with that are pointing in this direction (column 3, lines 48-52), though this is a development for special applications.

A person with ordinary skill in the art would provide the machine in US 4,763,053 with grooves. Even if he would have to accept the conditions of an air gap winding, he would rather change the machine to a build with inner poles to save machine volume, magnet surface and to use the stray field of the poles. He would not consider a further widening of the air gap or a better use of the folded region or the winding heads.

Claim 128

Information from claim 133 was used and "arranged in circular arc-form" was deleted for a better comprehension and for a better division of the claims.

Claims 129-131

Changes are the same as in claims 50-52.

Claim 136

In the claims 43-84 the claim 57 was translated incorrectly due to a mix-up with claim 11 of the original claims 1-37. The words "of uneven thickness" were added for better clarity.

Claim 153

The words "at an acute angle" and "uneven" were added, which makes claim more exact and understandable.

Claim 154

Some changes in claim 75 were taken back. The changes relating to the folded region are the same as in claim 124.

Claims 156 to 162

The added changes in claim 114 – 117 were taken over and some changes in claims 77 – 81 were taken back.

Claim 164

This claim is new and results from claims 82 and 53.

3. Concluding remarks

The implementation of highly efficient machines has a big economic, political and environmental meaning. As this was acknowledged in the last years, laws in the United States connecting to that were changed and a minimum performance for electrical machines was implemented (EPACT LAW). Due to above mentioned reasons and changes in the market a lot of companies and research centres in Europe started to make machines more efficient as well. All machines resulting from that are machines with iron filled windings. These machines are less effective than the machines of the here described invention, apart from that the invented machines have much better machine properties. This means that not only for the person with ordinary skill in the art, but also for experts specialized in this area, it is not obvious to develop the machines of the claims 122-164, considering the technical state of the art with the predominating background.

Not only would one have to go back to the beginnings of electrical machines around the year 1851, one would also have to adopt Faraday's views to build on the knowledge of that time and to connect this with today's technical potentialities considering today's demands on the newest generation of machines.

In view of the foregoing, Applicant respectfully submits that the application is now in condition for allowance.

Respectfully submitted,

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